INSTRUCTIONS

CRANKSHAFT AND MAIN BEARINGS

GENERAL ELECTRIC DIESEL ENGINES

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CRANKSHAFT

DESCRIPTION

The crankshaft, including the generator drive flange, is a steel forging, normalized and heat treated to improve its physical properties. All bearing surfaces, as well as the generator drive flange, are hardened to provide long service life and to add fatigue strength to the shaft. The crankshaft main journals and crankpins are of solid construction. Oil passages, drilled diagonally through the pins, intersect drilled passages in each adjacent main journal.

The forward end of the crankshaft is arranged with a flange used to mount the vibration damper, located just ahead of the No. 1 main bearing. The end of the shaft has several different diameters machined for mounting the pump drive gear hub, the forward end cover bearing and the barring-over hub (or the compressor-drive hub).

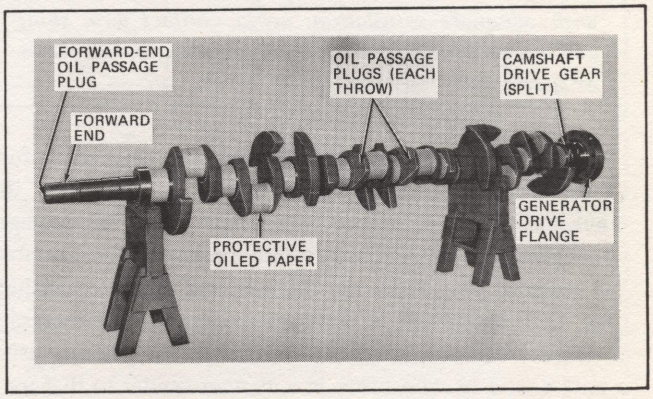
FORWARD-END OIL PASSAGE PLUG
FORWARD END
OIL PASSAGE PLUGS (EACH THROW)
CAMSHAFT DRIVE GEAR (SPLIT)
GENERATOR DRIVE FLANGE
PROTECTIVE OILED PAPER

FIG. 1. TYPICAL DETAILS OF SINGLE-PIECE CRANKSHAFT.

FIG. 1, E-9908C

A removable split-gear, mounted on the crankshaft just ahead of the generator drive flange, drives the camshaft gears and, through additional gearing, drives the control and overspeed governors. The gear is positioned on the shaft by a key and is held in place by two bolted clamping rings.

A group of numbers will be found stamped on the forward web of the No. 1 throw. Most important of these is the crankshaft serial number, which consists of seven digits preceded by the letter N or P (example: N-7404001). Always state this serial number, as well as the engine model and serial number, in all correspondence regarding the crankshaft. Other numbers, along with inspection stamps, are used for identification and recording of properties during manufacture.

SUPPORTING CRANKSHAFT

Immediately after the crankshaft has been removed from the engine, protective oiled paper must be placed around the journal surfaces to protect them. Place the crankshaft on two sturdy horses (Fig. 1) or on a heavy bench. For ease in cleaning and preliminary inspection, support the

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

crankshaft so it may be rotated freely. A tray may be placed below the crankshaft to catch drippings during cleaning. The same tray may also be used during magnetic particle inspection, if needed.

CLEANING

WARNING: *Solvents may be toxic or flammable and cause harmful or fatal injury. For safety, use only with adequate ventilation; avoid contact with skin; avoid inhalation of fumes; and do not expose to flame or sparks.*

The crankshaft must be thoroughly cleaned before inspection. Remove all oil-passage plugs from the crankshaft webs to afford free access to the oil passages connecting the main journals and crankpins. Also, remove the recessed plug from the forward end of the crankshaft (Fig. 1). Pour solvent into the oil passages and, if necessary to remove carbonized oil deposits, clean the passages using a stiff bristle or wire brush in a manner similar to that used when cleaning a gun barrel. Blow the passages clean using clean, dry compressed air.

CAUTION: *Install only oil passage plugs specially designed to minimize stresses around the plugged openings. Use of other types of plugs can cause failure of the crankshaft. When installing the forward-end oil plug, apply pipe thread sealing tape, Part 147X1638, on the plug threads. No sealant is required for the pipe plugs in the throws.*

If discoloration appears on journal surfaces, cleaning and polishing may be accomplished using 320-grit emery cloth and light oil. Polish evenly over the entire journal surfaces. Clean the surfaces and oil passageways thoroughly to remove all traces of abrasive grit and oil.

INSPECTION

Visual Inspection

CAUTION: *Extreme care must be exercised when inspecting the crankshaft to avoid any damage to bearing journals.*

Visually inspect the entire crankshaft. Mark any questionable areas with chalk or crayon for further attention during the magnetic particle inspection.

Inspect the generator drive flange. Machine to remove indentations in the generator mounting bolt seat area. See DATA section for limit.

Inspection Records

Each time the crankshaft is inspected, such as during heavy repair, pertinent information should be recorded. Preservation of these records will result in a permanent running history of each crankshaft. A suggested form for the crankshaft record is shown in Fig. 2.

Magnetic Particle Inspection

Two systems of magnetic particle inspection are suggested for use in detecting heat checks or fatigue cracks in a crankshaft. In both systems electrical current is used to produce the magnetic flux within the piece under inspection.

In the Magnaflux* system, the flux medium may be either a dry magnetic flux powder or magnetic particles suspended in a liquid vehicle.

In the Magnaglo* system, fluorescent magnetic particles are suspended in liquid. With this method, it is necessary to use ultra-violet light in a darkened area to observe the fluorescence.

Both methods lend themselves well to crankshaft inspection, providing the operator is thoroughly familiar with the required techniques. Due to the nature of magnetic particle inspection, no positive rules can be set forth. Accuracy and thoroughness of inspection can be gained only through experience.

Either commercial Magnaflux equipment or a substitute power supply may be used for magnetic particle inspection. In the latter case, both a-c and d-c welding equipments have been found to work satisfactorily. Current must be adjusted experimentally until a value which works well on the particular area under inspection is obtained. Be careful not to overheat the equipment supplying current by excessive demand for prolonged periods. Current-conducting cables must also be of sufficient size to avoid overheating.

Principles of magnetic particle inspection and typical arrangement of cables are shown in Fig. 3. In order to maintain a flux pattern strong enough to detect flaws when using equipment of limited current capacity, reduction of the area under inspection may be found necessary.

CAUTION: *When the crankshaft itself forms a part of the electric circuit, do not make contact on finished surfaces or on critical areas. Use web areas or crankshaft centers. Concentrated heat or arcing at points of contact may produce a change in hardness of shaft metal.*

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*Registered Trademarks of Magnaflux Corp.

CRANKSHAFT DIMENSIONAL INSPECTION SHEET

LOCOMOTIVE NO. ____________________
ENGINE MODEL ____________________
ENGINE SERIAL NO. ____________________
INSPECTOR ____________________
DATE INSPECTED ____________________

CRANKSHAFT STAMPING
(ON FIRST WEB)

GE DRAWING 41R992
PO NO. __________
PART NO. 119X
SERIAL NO. (N OR P)
HT __________
SPEC. __________
DATE OF MFG. __________

RESULTS OF MAGNETIC PARTICLE INSPECTION ____________________

RESULTS OF DYE PENETRANT INSPECTION ____________________

1	KEYWAYS	(a) BARRING-OVER HUB	DEPTH	WIDTH	LENGTH
		(b) PUMP DRIVE HUB	DEPTH	WIDTH	LENGTH
		(c) SPLIT GEAR	DEPTH	WIDTH	LENGTH
2	FREE-END TAPER		GAGE FIT	%	
3	TAPPED HOLES	– FREE END	CONDITION		
		– DAMPER FLANGE	CONDITION		
4	FLANGES	– DAMPER FLANGE	MAX. FACE RUNOUT		
		– GEN. DRIVE FLANGE	O.D.	MAX. FACE RUNOUT	
		– GEN. DRIVE PILOT	O.D.	MAX. FACE RUNOUT	
5	THRUST FACES		WIDTH BETWEEN MAX. MIN.	MAX. RUNOUT	FREE END DRIVE END
6	SPLIT GEAR FIT	(a) FREE-END SIDE	DIA.	MAX. RUNOUT	
		(b) LOCATING RIB	DIA.	MAX. RUNOUT	
		(c) DRIVE-END SIDE	DIA.	MAX. RUNOUT	
7	*FREE-END COVER BRG. JOURNAL		DIA.	MAX. RUNOUT	
8	PUMP-DRIVE HUB FIT		DIA.	MAX. RUNOUT	
9	VIBRATION-DAMPER HUB FIT		DIA.	MAX. RUNOUT	
10	COUNTERWEIGHTS, VISUAL INSPECTION		WELD CONDITION	BOLT TORQUE, 400-425 LB.-FT.	

*NOTE: ON TWO-PIECE CRANKSHAFTS, CHECK STUB-SHAFT RUNOUT WITH A VIBRATION DAMPER AND THE STUB SHAFT ASSEMBLED AND BOLTS TIGHTENED TO SPECIFIED TORQUE.

MAIN AND CRANKPIN JOURNALS NUMBERED FROM FREE END OF CRANKSHAFT

			1	2	3	4	5	6	7	8	9
11	MAIN BRG. DIA.	MAX.									
		MIN.									
		% BRG. SURF.									
12	WIDTH										
13	FILLET RADIUS	FREE END									
		DRIVE END									
14	PLATING THICKNESS										
15	MAXIMUM RUNOUT										

			1	2	3	4	5	6	7	8	9
16	CRANKPIN DIA.	MAX.									
		MIN.									
		% BRG. SURF.									
17	WIDTH										
18	FILLET RADIUS	FREE END									
		DRIVE END									
19	PLATING THICKNESS										
20	PIN PARALLEL & TWIST CHECK	VERT.									
		HOR.									
21	THROW LENGTH										
22	PHASE ANGLE										
23	CRANKSHAFT BENDING (END TO END) –										

RECORD SURFACE FINISHES ____________________

NICKS, GROOVES, SCORING, ETC. ____________________

REMARKS ____________________

FIG. 2. SUGGESTED CRANKSHAFT INSPECTION SHEET.

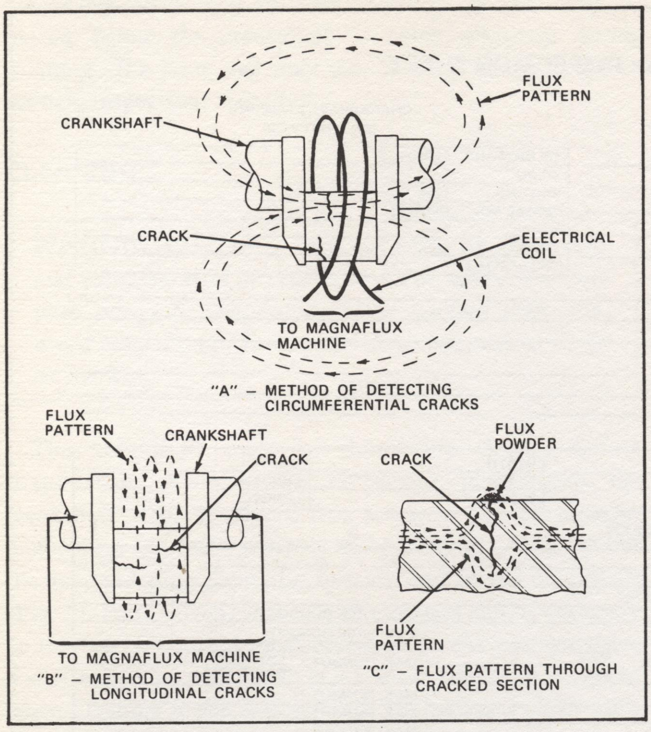

FIG. 3. CONDITIONS OF MAGNETIC PARTICLE INSPECTION.

Current passing through a coil wound around the crankshaft will induce magnetic flux in a direction to reveal cracks which are approximately at right angles to the centerlines of the crankshaft journals, pins, and web areas. This is shown in Fig. 3-A. Current passing directly through the crankshaft from end to end will induce magnetic flux in a direction to reveal cracks which are parallel to the centerlines of the journals, pins, and web areas. See Fig. 3-B.

Magnetic flux will pass through the crankshaft free from cracks or flaws because the magnetic resistance of the shaft is less than the surrounding air. If a crack or flaw is present on the surface of the shaft, the defect interrupts the passing of the magnetic flux, causing some to leave the shaft at the defect and enter the other side of the defect. When the flux leaves the shaft, it sets up magnetic poles each side of the defect, causing a strong magnetic attraction in the defective area. This strong attraction will draw the magnetic particles, when applied to the shaft, and cause them to collect over the crack or flaw, giving an indication that a defect exists, even though it may not be seen with the eye. See Fig. 3-C.

NOTE: *When magnetic particle inspecting the crankshaft, give special attention to the counterweight weld areas.*

Demagnetizing Shaft

After performing a magnetic particle inspection, it is IMPORTANT the shaft be demagnetized. This is necessary to prevent damage caused by metal particles adhering to the shaft during engine operation.

The shaft may be demagnetized by either of three general methods:

1. Apply a form-wound, movable coil around the shaft. Energize the coil using alternating current of high amperage; then, slowly pass the coil full length over the shaft and off at its extreme end.

2. Wind a spiral coil directly around the shaft. Energize the coil using alternating current of high amperage; then, slowly reduce the current to approximately zero.

3. Pass alternating current of high amperage directly through the shaft. Slowly reduce current to approximately zero.

The earth's magnetic fields will affect, to some degree, the amount of residual magnetism remaining in the crankshaft; therefore, during the demagnetizing process the crankshaft should be positioned so its ends face east and west, thus minimizing effects of the earth's magnetic field.

To determine the presence of magnetism in the crankshaft, a small pocket magnetic-field indicator or a compass may be used.

Dye Penetrant Inspection

Dye penetrant is a test devised primarily for detection of cracks in non-magnetic materials such as aluminum, chrome, and some types of stainless steel. It also works well for surface crack detection in most types of metal. In this method a colored liquid penetrant is applied to the surface to be tested. The surface is then wiped clean and a chalk substance is applied. After a period of time, if a crack is present, dye penetrant remaining in the crack will be absorbed into the chalk substance, resulting in a visible stain revealing the presence of a crack.

MEASUREMENT INSPECTION

Equipment Needed

1. One – Accurate surface plate, large enough to mount the crankshaft.

2. Adjustable V-blocks to support the crankshaft at all main journals.

FIG. 3, E-9580

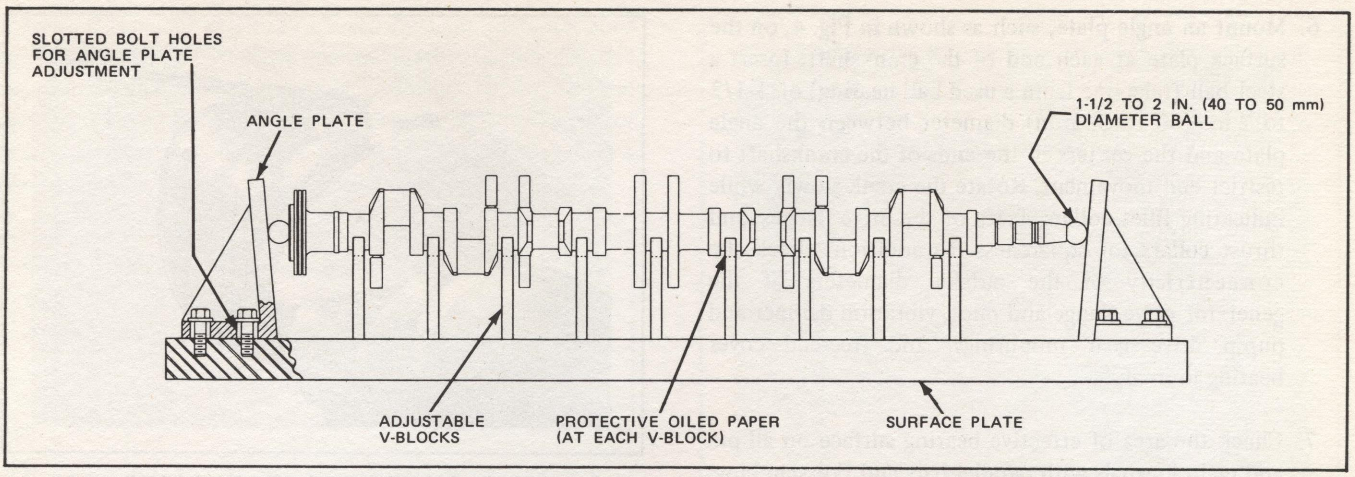
SLOTTED BOLT HOLES FOR ANGLE PLATE ADJUSTMENT
ANGLE PLATE
1-1/2 TO 2 IN. (40 TO 50 mm) DIAMETER BALL
ADJUSTABLE V-BLOCKS
PROTECTIVE OILED PAPER (AT EACH V-BLOCK)
SURFACE PLATE

FIG. 4. TYPICAL SETUP FOR MEASUREMENT INSPECTION.

FIG. 4, E-10004B

3. One – Vernier height gage, approximately one foot longer than the height of the supporting V-blocks.

4. One – Dial indicator, 0.015 in. (0,5 mm) range, for use with height gage.

5. Two – Angle plates and two steel balls. See Fig. 4.

6. One – Set of inside micrometers, 8 in. (200 mm) maximum capacity.

7. One – Set of outside micrometers, 18 in. (500 mm) maximum capacity.

8. Radius gages, 1/8 in., 1/4 in., 3/8 in. and 1-1/8 in. sizes.

9. Parallels, hardened and ground, to check journals for bearing area.

10. One – Taper gage, taper of 1-1/4 in. per foot, 4.922 in. I.D. at large end, 4-1/2 in. axial length (if desired).

Measurement Procedure

Proceed as follows on the crankshaft after it has been cleaned, visually inspected, and checked for cracks, checks, and other possible defects:

1. Mount the crankshaft on the surface plate, with a V-block under each main journal bearing. Place lubricated gasket material or oiled stencil paper between journals and V-blocks to prevent damage to the bearing surfaces and permit ease of rotation. See Fig. 4.

2. Using the sample inspection sheet as a guide, record all pertinent data. Be sure to include engine serial number.

3. Measure and record all diameters, widths, lengths, and other dimensions called for on the inspection sheet. Note any out-of-round condition present in the journals.

4. Level the crankshaft with respect to the surface plate using the height gage and dial indicator, adjusting the V-blocks as necessary. Rotate the crankshaft several times while moving the indicator from one main bearing to another to assure all are running true. (Allow for any out-of-round condition noted in Step 3, above.) If this check shows the crankshaft to be bent, the condition must be fully evaluated and corrected, if possible, before proceeding. See DATA section for bend limits.

5. After the crankshaft has been leveled and determined to be straight, check all crankpins for parallel and twist as follows:

   a. Rotate the crankshaft to place one pin in a vertical position and check, using the indicator, to determine if it is parallel with the surface plate. Repeat this operation for all pins. Pins must check parallel to within 0.001 in. throughout their length.

   b. Rotate the crankshaft to place one pin in a horizontal position and check, using the indicator, to determine if any twist is present. Absence of twist will be indicated by pins being parallel to the surface plate when in the horizontal position. Repeat for all pins. Pins must check parallel to within 0.001 in. throughout their length.

6. Mount an angle plate, such as shown in Fig. 4, on the surface plate at each end of the crankshaft. Insert a steel ball (take one from a used ball bearing) of 1-1/2 to 2 in. (40 to 50 mm) diameter between the angle plate and the centers in the ends of the crankshaft to restrict end movement. Rotate the crank slowly while indicating fillet collars, faces of the drive flanges, and thrust collars for squareness. In addition, check the concentricity of the outside diameters of the generator drive flange and pilot, vibration damper and pump drive gear mountings, and free-end cover bearing journal.

7. Check the area of effective bearing surface on all pin and main journals with parallel bars and Prussian blue. A minimum 75-percent bearing surface is required.

8. Normally, it is not necessary to check pins for angularity when inspecting a crankshaft. It may be assumed that if the alignment and pin parallel checks made in Steps 4 and 5 are within limits, pin angularity has not been affected.

BOLTED-ON COUNTERWEIGHTS

New and repaired crankshafts are sometimes fitted with bolted-on counterweights. If used, check the assembly bolts for tightness. Use Part 147X1823 ratcheting torque wrench with Part 147X1866 socket (1-1/8 in.) and apply 400-425 lb.-ft. of torque.

Unless damaged by another component failure, a bolted-on counterweight need never be removed during maintenance. If taken off, it must be reassembled in exactly the same location and position as originally installed. Otherwise, an imbalance may be imparted to the crankshaft. When reassembling the bolts, apply Molykote* "G-n" lubricant, Part 147X1143-1, to the bolt threads and tighten alternately in 100 lb.-ft. increments up to the final 400-425 lb.-ft. torque value.

NATURE AND CAUSES OF CRANKSHAFT DEFECTS

Metal Inclusions

Small natural metal inclusions may be found during magnetic particle inspection. Without close inspection, these may be mistaken for cracks. They will appear as pits or small checks containing iron sulphide or oxides. These inclusions are non-magnetic and will produce essentially the same indications as open cracks under magnetic particle inspection, except that ordinarily the lines will not be as sharp or as distinct as the lines associated with a true crack.

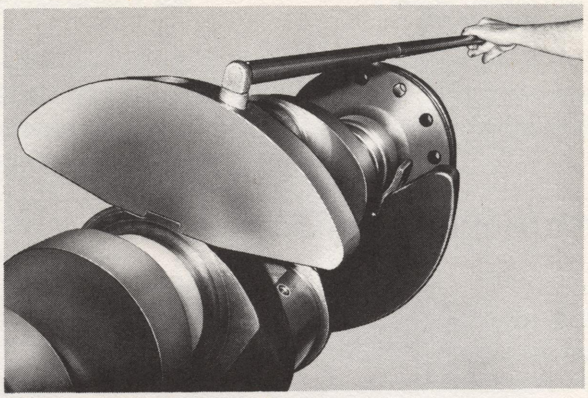

FIG. 5. TIGHTENING CRANKSHAFT COUNTERWEIGHT BOLTS.

FIG. 5, E-24277

Finding of natural metal inclusions in a crankshaft which has been in service for a period of time is not a condition for alarm. These inclusions have been investigated and judgment passed on them during manufacture.

Heat Checks

Heat checks are usually found as a series of short parallel cracks on a bearing surface extending longitudinally on that surface. See Fig. 6. Circumferential cracks may also be found in more serious cases. The latter are particularly difficult to detect due to associated scoring. Use of a magnifying glass may be helpful.

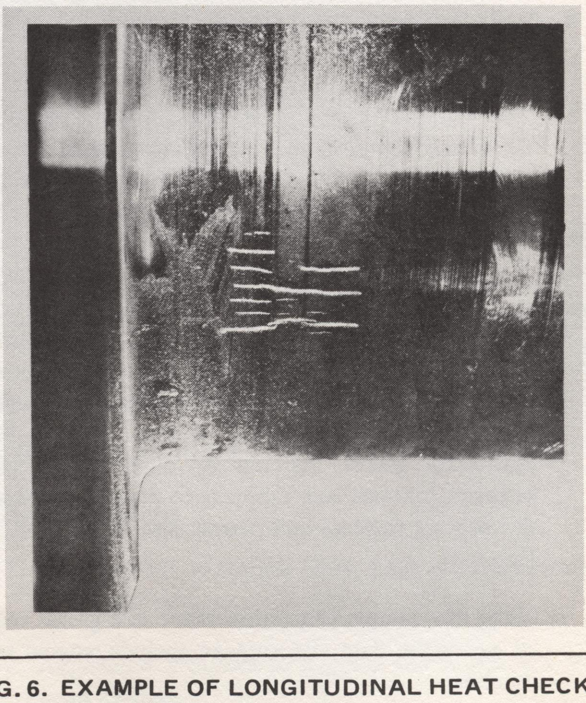

FIG. 6. EXAMPLE OF LONGITUDINAL HEAT CHECKS.

FIG. 6, E-9599

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*Product of Dow Corning Corp.

Heat checks are generally caused by high, instantaneous bearing surface temperature due to bearing seizure, and are usually associated with bearing discoloration. They will vary in size and number, depending upon the degree of bearing seizure, and may develop into a fatigue crack over a period of time.

> **CAUTION:** *Any crankshaft which shows indications of heat checks resulting from bearing seizure should not be returned to service until complete inspection and necessary repairs have been accomplished.*

Experience indicates that the depth of crankshaft heat checks and fatigue cracks will be approximately one-third their length on the surface. This is not a hard and fast rule. It is given only as an indication.

To investigate depth of heat checks while the crankshaft is undergoing magnetic particle inspection, use a small hand-held grinding tool with a conical stone. CAREFULLY explore the depth of the largest check by grinding.

Periodically conduct a magnetic particle inspection to determine when the crack has been completely removed. DO NOT GRIND DEEPER THAN IS ABSOLUTELY NECESSARY TO REMOVE THE CHECK.

Heat checks are generally too serious to be removed by dimpling. (See Correction of Crankshaft Defects.) Repairs may be accomplished by grinding the entire bearing surface to the depth necessary to remove the heat checks, followed by chrome plating to restore the bearing to its original diameter. See DATA section for allowable chrome plating thickness.

Repair becomes impractical if the heat checks are too deep or too numerous. The crankshaft will be weakened excessively in the process of removing deep defects.

Fatigue Cracks

Fatigue cracks ordinarily are at right angles to the centerline of the crankshaft. See Fig. 7. In most cases this type of crack will be found at or near a fillet where a journal joins a web. Fatigue cracks may, or may not, extend into the webs.

Fatigue cracks are more serious than heat checks, due to their comparatively rapid progression and the fact that they generally appear in highly stressed areas. They tend to be deeper, although the ratio of a depth approximately one-third that of their length continues to be true, as mentioned previously.

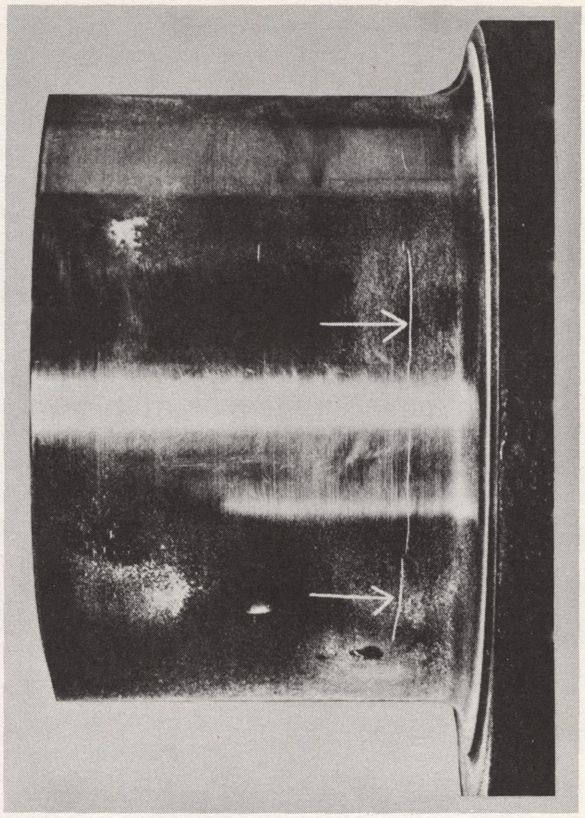

FIG. 7. EXAMPLE OF FATIGUE CRACKS.

Chief cause of fatigue cracks is crankshaft misalignment resulting in excessive stress on some portion of the crankshaft. Misalignment may be in the main journal bearings or in attachment of the generator to the engine. The crankshaft may also be bent, either in handling or in operation.

Fatigue cracks may be detected by magnetic particle inspection. When they are found, investigate them in the same manner as described previously for heat checks.

There is no recommended repair procedure for the following crank shaft defects:

1. Cracks which extend into the crankpin fillets

2. Cracks which extend into the main journal fillets.

Cracks which are located around the oil holes can be removed by increasing the 3/16 in. radius to 1/4 in. maximum.

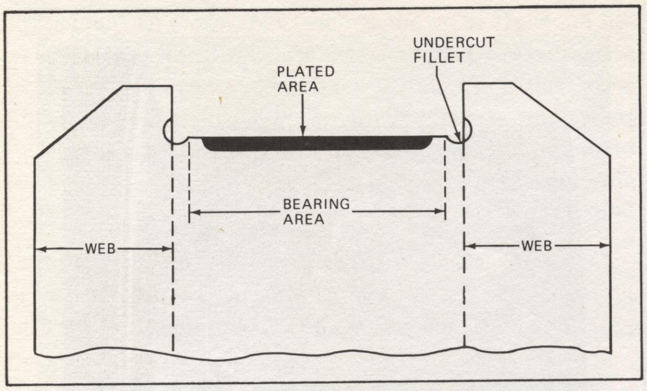

FIG. 8. CROSS-SECTIONAL VIEW OF CRANKSHAFT BEARING SURFACE SHOWING PLATED AREA.

FIG. 8, E-9586A

CORRECTION OF CRANKSHAFT DEFECTS

Dimpling

Removal of small surface defects by grinding and polishing is known as dimpling. Use of this procedure is limited to non-critical areas.

Straightening

Depending upon the pattern and amount of bending, it may be possible to straighten a crankshaft by peening the web areas. While the peening process itself is not complex, determination of the exact location to be peened to produce the desired effect on the shaft requires a high degree of skill.

Chrome Plating of Journals

Chrome plating has been found useful in rebuilding worn or damaged pin and main journals, thrust surfaces, tapered end of the shaft, and the split gear area. A typical plated area is shown in Fig. 8. See DATA section for allowable chrome plating thickness.

Special processes and techniques are required both in the plating operation and when grinding the journal surfaces.

NOTE: *NEVER use an aluminum bearing on a chrome plated journal. Consult the Renewal Parts Catalog for the correct bearings.*

Use of Undersize Bearings

The practice of grinding journals undersize, together with use of undersize bearings, is NOT RECOMMENDED. Loss of surface hardness and crankshaft strength will result. Undersize bearings are not available as standard stock parts.

CAUTION: *When serious crankshaft defects are found or suspected, contact the General Electric Company for assistance in evaluating the defects and recommendations for their correction.*

INSTALLING SPLIT GEAR

CAUTION: *The two halves of the split gear are manufactured as a matched set. Verify that both halves bear the same serial number.*

Inspect the gear halves for damage. Burrs on the teeth or the inner surfaces must be removed and the surface polished.

1. Clean the mating areas of the shaft and gear thoroughly.
2. Fit the gear key into the shaft.
3. Apply the gear halves to the shaft, aligning the roll pin dowel and its corresponding hole. Tap the gear halves into place using a lead or plastic hammer.

CAUTION: *Do not tap on the gear teeth.*

4. Apply the clamping rings loosely over the gear shoulders. The clamping ring split lines should be aligned with the split lines of the gear halves. See Fig. 10. Tighten the clamping-ring bolts evenly to their specified torque as shown in the DATA section.
5. If the gear is not seated on the shaft, it must be removed and the condition corrected. Refer to Fig. 11. If necessary, check the gear shaft and key for

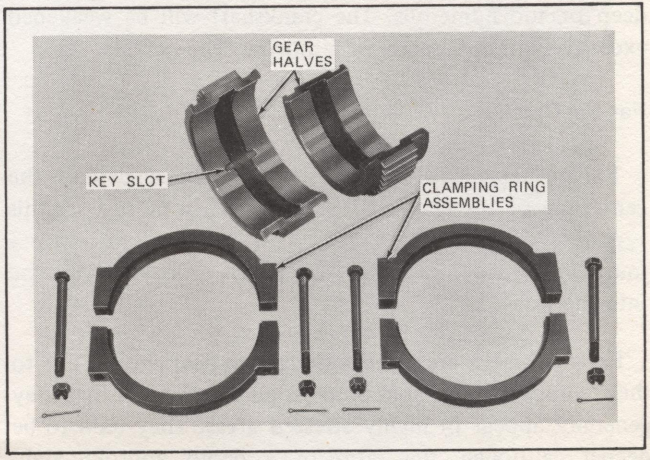

FIG. 9. CRANKSHAFT SPLIT DRIVE GEAR WITH CLAMPING RINGS.

FIG. 9, E-11674

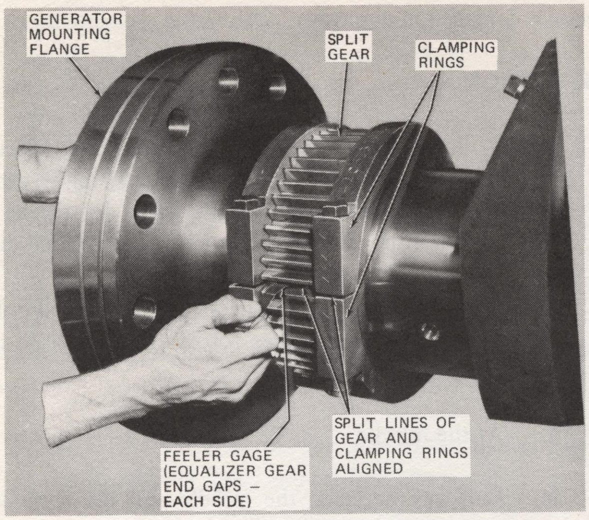
GENERATOR MOUNTING FLANGE
SPLIT GEAR
CLAMPING RINGS
SPLIT LINES OF GEAR AND CLAMPING RINGS ALIGNED
FEELER GAGE (EQUALIZER GEAR END GAPS – EACH SIDE)

FIG. 10, E-13203

FIG. 10. ASSEMBLING SPLIT GEAR ON CRANKSHAFT (EQUALIZING GEAR END GAPS).

high spots by bluing the inner surfaces. If high spots are found, they should be carefully hand scraped and polished to give correct end gap.

MAIN BEARINGS

DESCRIPTION

Semicircular bearing shells support the crankshaft within the engine. They are secured by bearing caps which are bolted in place.

The bearing shells are precision type and are replaceable without machining or scraping. Each bearing shell has a steel back which supports two or more layers of carefully formulated bearing material.

In the past, identical bearing half shells having a center oil groove were used in both the main-frame bearing saddle and in the bearing cap (the top/bottom or upper/lower bearing positions). Since mid-1976 some new-production engines were equipped with a grooveless bearing shell in the lower position; the conventional bearing shell with oil groove was retained in the upper position. Absence of the groove in the lower bearing shell results in a thicker oil film, lower unit-area loading, and higher lube-oil header pressure.

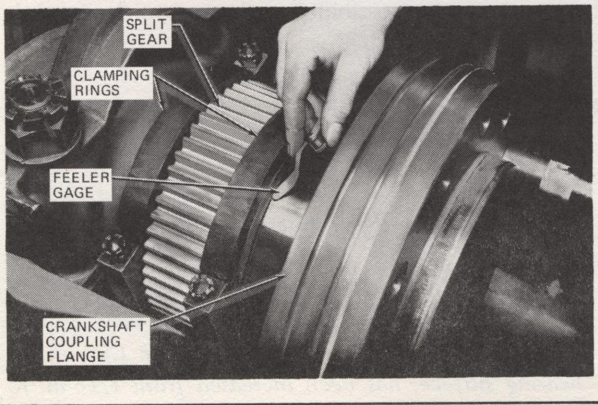

FIG. 11, E-11676

FIG. 11. ASSEMBLING SPLIT GEAR ON CRANKSHAFT (CHECKING GEAR-TO-SHAFT FIT).

Each bearing half with oil groove contains one locating tab which locates and secures the half shell in its correct position; each grooveless bearing half contains two locating tabs which prevent inadvertent installation in the upper position. See Fig. 12.

Bearing half shells with grooves may continue to be used in both the upper and lower positions; grooveless bearing half shells may be used only in the lower position, providing the bearing cap has two slots to accommodate the two tabs. For adding a second slot to bearing caps, refer to instructions under ENGINE MAIN FRAME AND GENERAL ASSEMBLY in Section DE-2.

> **CAUTION:** *Under no circumstances should a grooveless bearing be installed in the upper position. With all oil to that journal blocked off by the grooveless bearing, the engine can be expected to fail in only a few revolutions of the crankshaft.*

Each bearing shell is stamped along its edge with a serial number, catalog number, drawing number, and the nominal wall thickness.

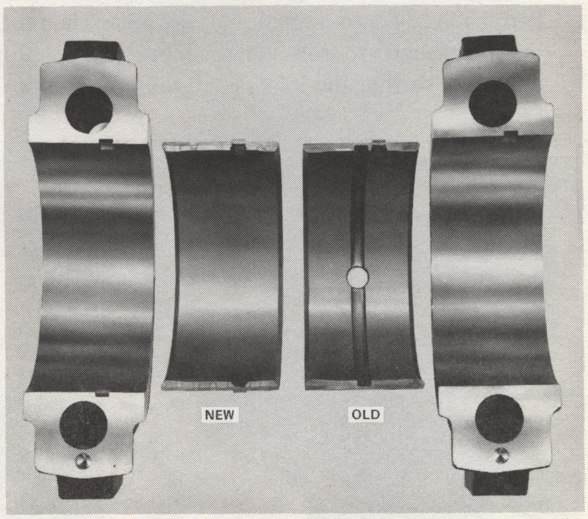

FIG. 12, E-24226

FIG. 12. GROOVELESS LOWER MAIN BEARING AND CAP WITH TWO LOCATING SLOTS ARE SHOWN ON THE LEFT. OLD-STYLE GROOVED BEARING AND CAP WITH ONE SLOT IS AT RIGHT.

When removing the main bearing shells from the engine, always record the location of the bearings by serial numbers and corresponding bearing-cap numbers. Bearing shells, if in good condition, must be returned to their original position within the engine and used only with the same crankshaft, since running will have seated them to their respective locations.

The bearing shells MUST NOT BE FILED OR SHIMMED TO FIT. They are precision made to fit with exact running clearances. When wear becomes excessive, they should be renewed.

REMOVAL

NOTE: *Refer to LOCOMOTIVE MAINTENANCE TOOLS, GEG-14700, for specialized tools available for performing this operation.*

To remove a main bearing, use the following procedure:

1. Loosen the cap nuts two to three turns.
2. Remove the bearing-cap side bolts and loosen the side bolts of the adjacent bearings.

NOTE: *To facilitate removal of the cap from the frame, spread the frame slightly using a frame expander, Part 147X1314 (mechanical) or 147X1742 (hydraulic).*

3. Loosen the bearing cap by tapping downward with a lead hammer or brass drift.
4. Remove the nuts and cap containing the lower half shell. Keep a firm grip on the bearing cap, as it is heavy.
5. Usually the upper half shell can be rolled out by hand. However, it may be necessary to apply the barring-over tool to the engine and a removing tool, Part 147X1342, to a crankshaft oil hole. Then rotate the crankshaft to roll the shell out in the proper direction, so that the locking tab rolls out and not in, Fig. 13.

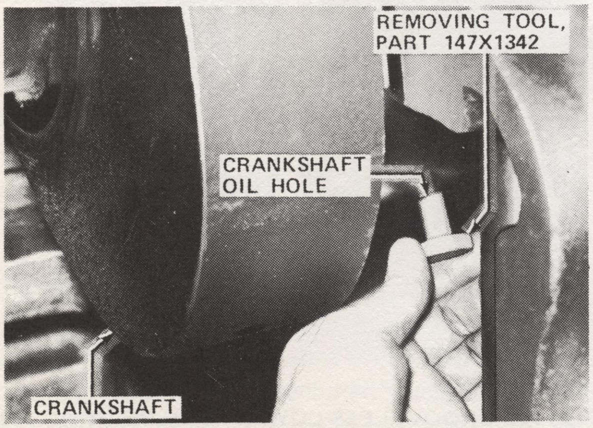

FIG. 13. INSERTING MAIN-BEARING REMOVING TOOL IN OIL HOLE.

FIG. 13, E-25975

Handle the bearing shells carefully so they do not become damaged in any way.

INSPECTION

1. Clean the bearing shells and inspect the bearing surfaces for pitting, shelling, cracks, and other defects. Inspect the back of the shells for cracks or signs of improper seating. Remove any imbedded dirt.

2. Measure the shell thickness using a ball-point micrometer at three places across the surface in the following areas:

    a. At the middle

    b. Half-way between the middle and the split line on each side of center.

3. Replace bearing if:

    a. Shell thickness is less than the worn limit. See DATA section.

    b. Bearing metal is excessively worn and bronze backing material is exposed.

    c. The difference in shell thickness between adjacent bearings exceeds the limit given in the DATA section.

If a bearing is replaced, the adjacent bearings must be measured and their shell thickness compared to the new shell thickness. If the maximum difference exceeds the value given in the DATA section, these bearings must also be replaced. This rule applies to all used bearing shells which have been removed from the engine for inspection and measurement.

Failure to follow this procedure will result in damage to the bearing and a possibility of damage to the crankshaft.

INSTALLING BEARINGS

NOTE: *The 8, 12 and 16 cylinder engine crankshafts have been upgraded for use in higher horsepower engines by increasing the main journal fillet radius from 1/4 in. to 3/8 in. In conjunction with this main journal fillet change, the main bearing shell chamfer, at the outer edge of the I.D. of the bearing surface, has been increased from 1/16 in. to 3/16 in. to insure clearance between the bearing shell and the main journal fillet at all times.*

Bearing shells with the 3/16 in. chamfer may be used on crankshafts with either the 1/4 in. or 3/8 in. main journal fillet radius. Bearing shells with the 1/16 in. chamfer must be used only with crankshafts with the 1/4 in. main journal fillet radius.

Refer to Renewal Parts bulletins for specific catalog numbers of parts affected.

Inspect the crankshaft journal to assure it is in good condition. In the event of a main bearing failure, inspect for conditions as outlined under crankshaft inspection and repair.

1. Clean the surfaces of the crankshaft journal, main frame, bearing shells and bearing cap.
2. Coat the journal and inner bearing surfaces with clean engine lube oil.
3. Roll the upper bearing shell into place. To avoid damage to the bearing, assure the lock tabs are properly seated.
4. Seat the lower shell in the bearing cap.
5. Position the bearing cap on its dowel and apply the cap nuts and side bolts. Use new O-rings on the bearing-cap side bolts, and apply Lubriplate Spray Lube "A"*, GE Part 147X1614, to the O-rings and the washer face and threads of the bolts. Also apply Molykote G-n†, GE Part 147X1143-1, or Lubriplate to the threads and contact face of the stud bolt nuts. While either lubricant is acceptable, less torque will be required when using Molykote to achieve the stretch value for the stud bolts.
6. Assemble the side bolts and stud bolt nuts finger tight. Further tighten the side bolts to approximately one-fourth the final recommended torque, finish tightening the stud bolt nuts by stretching the bolts to the value given in the DATA section, then finish tightening the side bolts to the torque value given in the DATA section.

THRUST COLLARS

Two half-ring thrust collars, fitted to the engine frame at the second main bearing from the generator-end, control the axial thrust of the crankshaft. These collars are loosely fitted and are held in place by the main bearing cap and the crankshaft.

Each thrust collar is marked at its outer edge with a serial number, catalog number and drawing number.

The collars are of solid bronze, have a heavy lead-tin plate on the thrust-bearing surface and a thin lead-tin flash plate all over.

The bearing face of the collar can be identified by its radial oil grooves, as shown in Fig. 14. WHEN INSTALLED, THE SIDE OF THE COLLAR CONTAINING THE OIL GROOVES MUST FACE THE CRANKSHAFT.

To determine if renewal of the thrust collars is necessary, the crankshaft thrust clearance should be measured. See the DATA section and the method described in ENGINE MAIN FRAME AND GENERAL ASSEMBLY. To determine if both thrust collars must be renewed, measure the thickness of each collar, using micrometers. See the DATA section for NEW THICKNESS.

For futher information covering the removal and installation of main bearings and thrust collars, see ENGINE MAIN FRAME AND GENERAL ASSEMBLY.

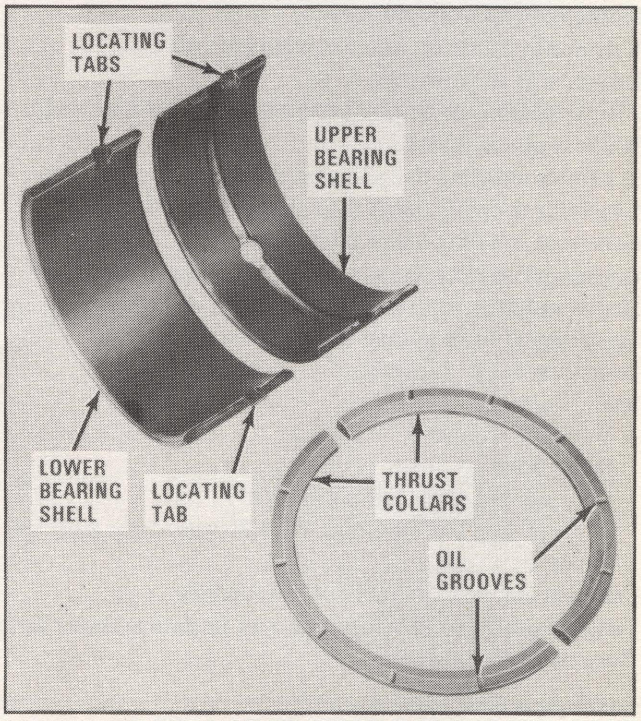

FIG. 14. MAIN BEARINGS AND THRUST COLLARS. △

FIG. 14, E-26251

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*Product of Fiske Bros. Refining Co.
†Product of Dow Corning Corp.

△Revisions are indicated by marginal bars.

DATA

CRANKSHAFT

	Approximate Weight (for lifting purposes only)	Total Length	Crankpin Angularity (degrees)	Width of all Main Journals									Applies to decimal dimensions only
				No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	
8 Cyl.	2200 lbs. (998 kg)	8' 11" (2718 mm)	180	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4.502" (114,35 mm) 4.500" (114,30 mm) △	4 1/2" (114,3 mm)					Max. Min.
12 Cyl.	3600 lbs. (1633 kg)	11' 8" (3556 mm)	120	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4.502" (114,35 mm) 4.500" (114,30 mm) △	4 1/2" (114,3 mm)			Max. Min.
16 Cyl.	4000 lbs. (1814 kg)	14' 5" (4394 mm)	90	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4 1/2" (114,3 mm)	4.502" (114,35 mm) 4.500" (114,30 mm) △	4 1/2" (114,3 mm)	Max. Min.

△Thrust surfaces may be reworked to a width of 4.520 in. (114,81 mm) but reworked surfaces must be a 10 micro inch finish, or better.

	New				Worn Limit	
	Max.		Min.			
	in.	mm	in.	mm	in.	mm
Shaft bend limit (end to end)*					0.010	0,25
Diameter of all main journals	8.000	203,20	7.998	203,15	7.997	203,12
Variance in diameter, adjacent main journals	0.001	0,03			0.001	0,03
Diameter of all crankpins	7.437	188,90	7.435	188,85	7.434	188,82
All crankpins must be parallel to shaft within (their length)	0.001	0,03				
Width of all crankpins	6.005	152,53	6.000	152,40	6.030	153,16
Generator coupling flange diameter	18.000	457,20	17.998	457,15	17.998	457,15
Generator coupling flange face axial run-out**	0.002	0,05			0.002	0,05
Generator coupling flange pilot diameter	11.999	304,77	11.998	304,75	11.997	304,72
Generator coupling flange pilot diameter radial run-out**	0.002	0,05			0.002	0,05
Maximum swing from crankshaft journal centerline	12 5/8	320,68				
Centerline of main journal to centerline of crankpin	5.255	133,48	5.245	133,22		
Generator flange thickness	3 1/2	88,9			3 1/4	82,55
Shaft Diameters:						
Vibration damper	5.498	139,65	5.496	139,60		
Pump drive	5.2535	133,44	5.252	133,40		
Forward-end cover bearing journal	4.996	126,90	4.994	126,85	4.993	126,82
Taper at gage line - 4-1/2 in. (114,30 mm) from shaft end	4.922	125,02	4.920	124,97		
Taper	1 1/4 in. per foot length					
Crankpin and main journal out-of-roundness	0.0005				0.001	
Finish required on all bearing surfaces (including thrust surfaces)	10 micro inches					
Dynamic shaft unbalance	20 oz. in.					

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*If a shaft is bent over 0.010 in. (0,25 mm) but not more than 0.040 in. (1,02 mm), it must be straightened. Any crankshaft with a bend over 0.040 in. (1,02 mm) should be removed from service.

**Runout TIR taken with shaft in V-blocks.

DATA (Cont'd.)

CRANKSHAFT (Continued)

	New				Worn Limit	
	Max.		Min.			
	in.	mm	in.	mm	in.	mm
Keyways						
Split gear						
Length	1-1/4 in. (31,75 mm)					
Width	0.501	12,73	0.499	12,67	0.503	12,78
Depth	1/4 in. (6,35 mm)					
Barring-over hub						
Length	5 in. (127 mm)					
Width	1.006	25,55	1.004	25,50	1.007	25,58

Recommended chrome plating thickness of crankshaft journals

Crankshafts for 8-cylinder engines at 1420 gross horsepower	0.005 in. (0,13 mm) min., 0.015 in. (0,38 mm) max.
Crankshafts for 8-cylinder engines with a gross horsepower greater than 1420	Chrome plating crankshaft journals is not recommended.
Crankshafts for 12-cylinder engines at 2150 gross horsepower	0.005 in. (0,13 mm) min., 0.015 in. (0,38 mm) max.
Crankshafts for 12-cylinder engines with a gross horsepower greater than 2150	Chrome plating crankshaft journals is not recommended.
Crankshafts for 16-cylinder engines at 2750 gross horsepower	0.005 in. (0,13 mm) min., 0.015 in. (0,38 mm) max.
Crankshafts for 16-cylinder engines with a gross horsepower greater than 2750	Chrome plating crankshaft journals is not recommended.

SPLIT DRIVE GEAR

End gaps between gear halves, gear installed	Less than 0.0015 in. (0,04 mm)
Gear-to-shaft fit	Feeler gage 0.0015 in. (0,04 mm) must not enter between gear and shaft at any point.

MAIN BEARINGS

Wall thickness	Max. new: 0.3722 in. (9,45 mm); Min. new: 0.3711 in. (9,43 mm); Worn limit: 0.370 in. (9,40 mm)
Difference in shell thickness between adjacent bearings, max.	0.001 in. (0,03 mm)

THRUST COLLARS

Thickness	
New	0.436 in. (11,07 mm) to 0.4370 in. (11,10 mm)
Crankshaft thrust clearance	Max. new: 0.018 in. (0,457 mm); Min. new: 0.008 in. (0,20 mm); Worn Limit: 0.040 in. (1,016 mm)

DATA (Cont'd.)

TORQUE VALUES

	lb.-ft.	N·m
Split drive gear		
Clamping bolts	120-140	163-190
Main bearing caps		
Side bolts	265-275	359-373
Cap nuts, 8 cylinder	stretch studs 0.025 to 0.027 in. (0,64 to 0,69 mm)	
Cap nuts, 12 and 16 cylinder	stretch studs 0.027 to 0.033 in. (0,69 to 0,84 mm)	
Crankshaft plugs*	65-80	88-108
Crankshaft counterweight bolts	400-425	542-576

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*The plugs should be staked in place with two marks 180 degrees apart.